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Combat Service Support Model Development

BRASS -- TRANSLOG -- ARMY 21

Contract Number DAAK11-84-D-0004
Task Order #1

DRAFT REPORT

July 1984

By: B. M. Davall
D. J. Shearin, Sr.
G. A. Kupets, Sr.

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Prepared By:

Armament Systems, Inc.

211 West Bel Air Avenue
P.O. Box 158
Aberdeen, MD 21001

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ARMAMENT SYSTEMS, INC.

13 July 1984

Director
US Army Human Engineering Laboratory
ATTN: DRXHE-CSSD (Mr. J. Stephens)
Aberdeen Proving Ground, Maryland 21005

Dear Mr. Stephens:
RE: Combat Service Support Model Development: BRASS - TRANSLOG - Army 21,
Contract Number DAAK11-84-D-0004, Task Order #1.

Enclosed are two copies of the draft report for this task for your review and comment.

Sincerely,

B. M. Davall
Vice President

BMD/geh

Enclosure: A/S

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PREFACE

Working on this task has been similar to trying to paint a moving train. The Army is undergoing some significant changes in its concept for organization and the terminology that is used to support the concept.

The "Light Division" is currently being studied and the first division will probably be organized and fielded during Calendar Year 1985. The light division is not addressed as part of this task for two reasons. First, it was not assigned as a specific task order. HEL's primary interest is in the European Theatre where high tonnages of ammunition must be moved in short periods of time. Secondly, the ammunition expenditure rates and the types of ammunition that the light division will use will not be a significant challenge to the logistical system. This is not to imply that ammunition resupply may not be a problem for the light division. There is a paucity of cargo vehicles within the division. However, the logistical system that supports the division should not be taxed in terms of very high tonnages of a wide variety of ammunition that must be delivered to the division.

The terms Airland Battle, Airland 2000, The Army of Excellence, Division 86, Army 21, Brass 2000, etc., are all being bandied about. During the period 1985 to 1990 the Army will accept approximately 400 new items of equipment and the basic concept for revising the current organizational structure into light and heavy division for this equipment has not changed. However, the terminology used to describe these various organizations is in a state of flux.

The reader must keep in mind that the evolutionary progress that the Army will make between now and the end of the century is going to be essentially in two phases.

- Phase One will be devoted to organizational changes that will incorporate the new equipment and will reflect the emerging new technology in computers and communication that will add significant sophistication to the command and control system within the Army.

- Phase Two will be doctrinal and tactical employment changes that will capitalize upon the increased capabilities afforded by the new equipment and organizations as well as the enhancement of command and control made possible with the introduction of the new sophisticated communications equipment.

The reader should keep in mind that the general problems associated with moving high tonnages of ammunition will remain the same. It may sound trite, but a ton is still a ton, a mile is still a mile, and an hour is still an hour regardless of the organization, doctrine, tactics, or terminology used to describe

them. The Army's problems associated with ammunition resupply continue to be severe. The workload is not going to diminish by changing the name of the organizational units being supported, or the tactical doctrine being employed.

Therefore, the reader is asked to try to digest the essence of this report which attempts to quantify the magnitude of the ammunition resupply problem during the near term (1984-1995), and into the far term when the new tactical doctrine will be employed.

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1.0 INTRODUCTION

For the past five years, the US Army Human Engineering Laboratory (USAHEL) has been involved in research studies of the Army's logistical (Combat Service Support) system. This research has been very successful and has gained wide acceptance at all levels of the Army. In order to continue the momentum of this program, significant efforts must be expended to develop the programs, procedures and doctrine to transition from today's system, through the organization changes of the Division 86 period, to a logistical system that is fully capable of supporting the doctrine set forth in the Army 21 concept.

On the surface, this transition may appear to be more revolutionary than evolutionary. However, since revolutionary changes are usually too drastic to be acceptable, a well developed set of transitional programs must be developed. Although these programs must be dynamic and aggressive, they must also be acceptable to, and usable by, the entire (wholesale and retail) logistical community, as well as the tactical arms that the logistical system ultimately supports.

In addition to the development of the transitional logistics (TRANSLOG) programs, the need for short term support for detailed analyses of current or near term specific logistical problems focused on, but not limited to, Class V will continue to arise. Also, the requirement exists for the Army to have the capability to continue to integrate robotic applications into transitional logistics. This requirement can span the logistical system from

the manufacturing plant, through the CONUS depot and transportation system, through the OCONUS ports, through in-theater depots and storage areas to the final customer. These robotic applications may be broad in nature or detailed, specific applications such as have been developed in the BRASS concept.

→ Allied to robotics is computer automation which will be required throughout the system. Transitional problems may address specific hardware and related software, such as the Standard Army Ammunition System (SAAS) Level 4, through the integration of computers with outside communications nets and internal control of robots.

Since the primary role of the USAHEL is to support the human operator, his interface with the transition of the logistical system and all of its components must receive continuous and detailed attention. This requirement can vary from the location and type of controls on a specific item of hardware, through the performance of operators wearing Mission Oriented Protective Posture (MOPP) gear, to the intelligent interface (I^2) between a robotic sensor and the human monitor in a more complex system.

2.0 OBJECTIVE

→ The objective of this report is to provide an expanded analysis of the BRASS program to assess its applicability to the Combat Service Support Concept as envisioned for Army 21. To meet the requirements of this expanded analysis, the following tasks were prescribed. JME

a. Provide a narrative description of the Combat Service Support Concept for Class V for Army 21^{1/}.

b. Develop macro flow charts of the conventional Class V in-theater resupply system to include theater level, general and direct (BRASS concept) support and the using units.

c. Develop micro flow charts of the interface [events] between the general support Class V units and the user units.

d. Based on a nominal resupply rate of 1,000 short tons per committed brigade per day, develop estimates of:

- (1) The number of ARMs required
- (2) The GS transportation requirements
- (3) The ARM thruput requirements
- (4) The user transportation requirements
- (5) An estimate of the reconstitution time required

per committed brigade assuming a conventional battlefield.

1/ At the time the task order was prepared, references were made to BRASS 2000 and Air-Land Battle 2000. Since that time, the BRASS 2000 term has been changed to BRASS and the title Air-Land Battle 2000 has been changed to Army 21. These new terms are used throughout this report.

3.0 METHOD/APPROACH

The first step in the approach was to obtain copies of studies and presentations on Army 21 and review those portions pertaining to the concept for logistical support, particularly as relates to ammunition resupply. This literature search was supplemented by visits to the Office of the Deputy Chief of Staff for Logistics (ODCSLOG) at the Department of the Army (DA), and the Missile and Munitions Center and School (MMCS) where discussions were held with individuals engaged in the development of logistical support doctrine for Army 21. Based on the review of Army 21 literature and discussions with key logistics doctrinal personnel, a narrative description of the Combat Service Support and macro and micro flow charts were developed depicting Class V ammunition flow through the supply chain. The final step was to compute the number of ARMs and the transportation requirements based on the resupply rate of 1,000 short tons per committed brigade per day and a total of 4545 short tons per day for a Heavy Armored or Mechanized Infantry Division (J Series TO&Es). The published literature indicated that reconstitution of a regiment (The Army 21 equivalent of a Division 86 Brigade Slice) with all classes of supplies, personnel, weapons, and equipment should be accomplished within approximately 45 minutes. Based on the results of the HELFAST I & II tests, this is an extremely optimistic time and, unless there are major breakthroughs in field material handling equipment (MHE), a more realistic time is two to five hours.

4.0 DISCUSSION

4.1 Operational Concept for the Combat Service Support (CSS) for Class V of the Air Land Force (ALF), Army 21

4.1.1 General. In order, for one to understand the CSS for ammunition in the ALF, one must first understand the essence, characteristics and terminology associated with Army 21. The timeframe for Army 21 is 1995-2030. In the private sector, one can expect a 20% decrease in the military age population and a large increase in the civilian workforce. The largest segment of the population available for military service to the Army will be female. Most of these women will be assigned to Combat Service Support units. The essence of Army 21 is a style of waging war in which agility, deception, maneuver, and firepower are used to confront the enemy with a succession of dangerous and unexpected situations more rapidly than he can react to them. The implications are that the forces must be prepared to fight anywhere. The Army must be able to orient or focus on an enemy force in any manner required to win the land battle. The quality of enemy weapons will result in weapon parity wherein combat losses can be expected to be high. Initial battles will be critical and strategic mobility will be imperative.

The Army 21 characteristics include a battle that will be expanded into the air space and depth of enemy formations. Intensive battles will occur at the decisive point in an environment of chemical/nuclear and electronics warfare. Large quantities of sophisticated combat systems will be encountered.

Command and control will be difficult, and there will be no single dominating weapon system. The forces will be smaller, highly mobile, self sufficient and capable of continuous operation. They will be less manpower reliant and able to cross obstacles in stride. There will be a built in redundancy in command and control. The prevalent technology supporting the Army 21 environment will include artificial intelligence, robotics, directed energy (lasers and particle beam), micro-electronics, new energy sources, smart weapons with brilliant munitions and improved armor.

The battlefield will be dominated by the principles of deep attack, rear area operations, and close in fighting, all of which will be inseparable. CSS units will be prime targets for NBC attack. Decisive battles will be won by highly maneuvering forces which are capable of waging major attacks against the enemy flanks and rear. The primary objective of such principles will be to react faster than the enemy thus preventing him from completing one tactical response before another is required.

4.1.2 The Airland Force. Figure 1 is an organizational chart of the Airland Force (ALF). The ALF is subordinate to the Theater command if one exists. The ALF commander executes Corps and Echelons Above Corps (EAC) functions. The ALF commander exercises direct command and control over his close combat forces or "regiments". The ALF commander may exercise tactical command and control over a number of regiments through the Battle Task Force (BTF).

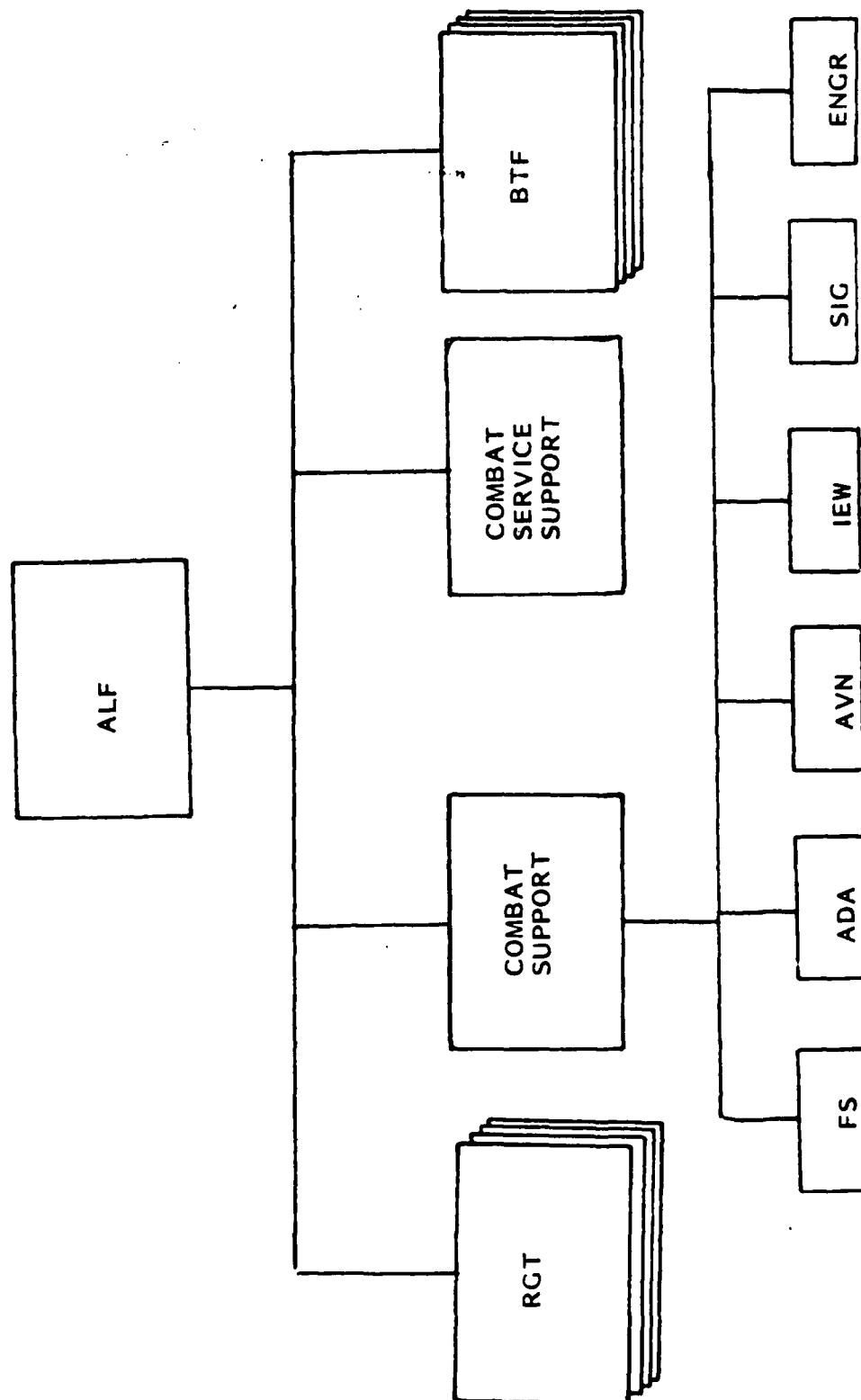


Figure 1. The Airland Force.

The regiment is the primary tactical organization that conducts close combat. Regimental operations are oriented on defeating the enemy's will to fight rather than securing terrain. The regiment consists of 4000-6000 personnel and is capable of independent operations. It possesses organic combat support and combat service support elements with the capability of carrying 3-5 days of supply. It has a 360 degree orientation, and is 100% mobile.

4.1.3 Concept of Operations. As shown in Figure 2, the battlefield will be divided into three battle areas: Immediate Battle Area (IBA); Extended Battle Area (EBA); and Extended Reconnaissance and Surveillance Area (ERSA).

a. IBA is the battle area needed for close combat forces to maneuver and concentrate their organic combat power. It may be analagous to the 1980's FEBA or Forward Edge of the Battle Area, or may be circular and deep in enemy territory.

b. EBA is an extension of the IBA in all directions to provide sufficient space for defense and allow time to apply the direct and indirect supporting fires and maneuver necessary to win the battle.

c. ERSA is an extension of the EBA in all directions to locate and target the enemy and for defense. Conduct of the battle in this area is the responsibility of the next higher echelon of command.

4.1.4 Force Organization. The force will be characterized by small elements dispersed throughout the

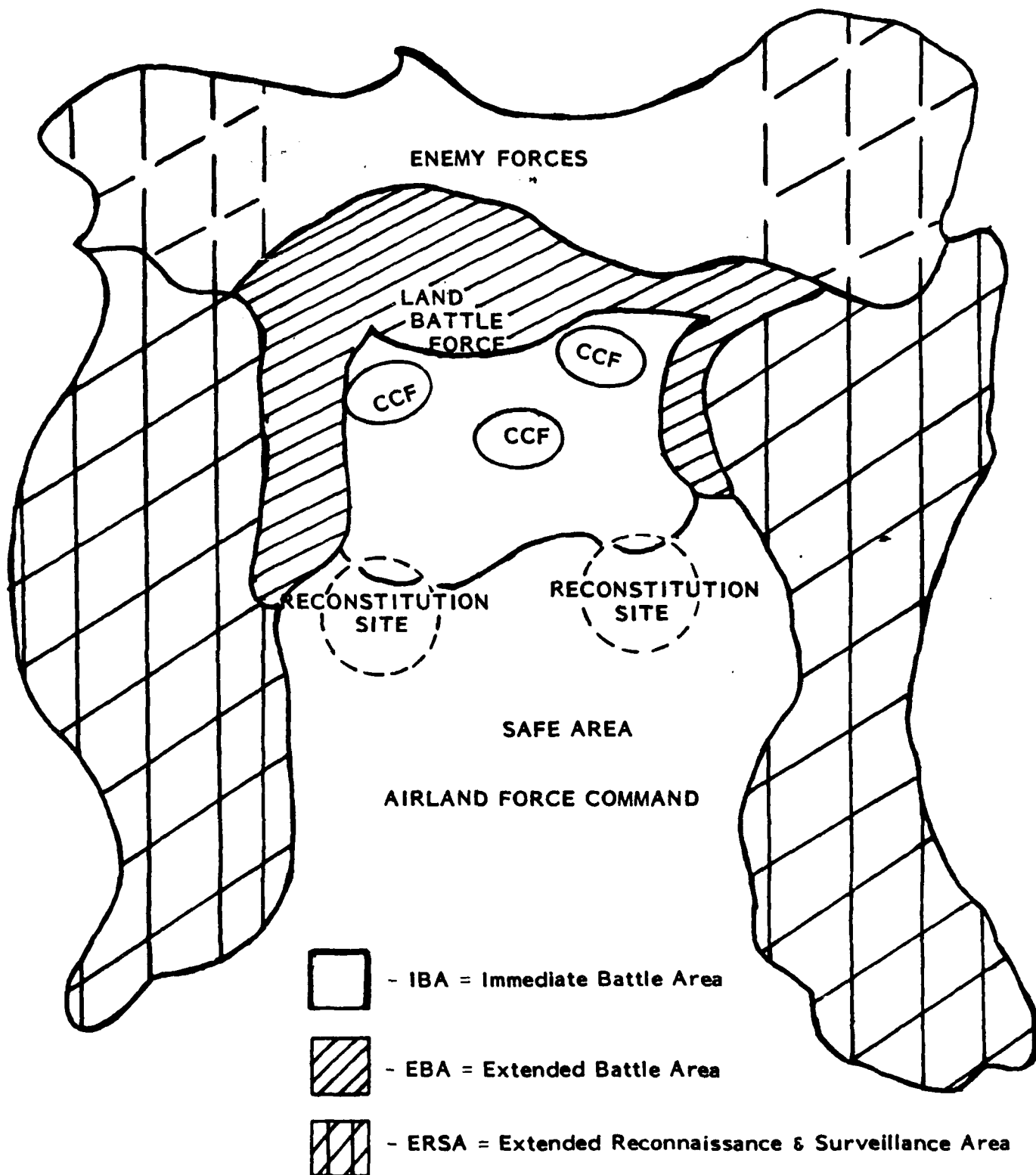


Figure 2. Army 21 Battlefield.

battlefield. The three basic echelons within the area of operations will be: Close Combat Force (CCF); Battle Task Force (BTF); and Airland Force Command (ALF).

a. CCF. The CCF is a regimental size force as described in previous pages. This would equate to a Brigade with its slice of the Division Artillery and Support Command in today's Army or the Division 86 Army. The CCF will be the primary combat organization capable of sustained, independent operations. The CCF will have its own combat service support (CSS) elements and will be comparable in size to today's brigade. Typically, it's combat forces would be a combination of armored and mechanized infantry battalions, supported by a direct support (155mm) self-propelled artillery battalion, plus other combat and combat service support units.

b. BTF. The BTF (Battle Task Force) would equate to a Division Headquarters without the Division Artillery and Support Command found in today's Army or the Division 86 Army. The BTF will coordinate and direct the close combat forces. The command will contain Air Force liaison elements to integrate air-ground war. It will not have CSS elements, but may have a limited CSS staff.

c. ALF. The ALF is a joint air/land force headquarters that integrates the airland battle. It coordinates and directs close combat forces (regiments) using intermediate command and control elements such as BTFs, as necessary to assist in the span of control. The command will be tailored to support

the operations. It will be the command directly interfacing with the sustaining base. Although the CONUS/theater sustaining base interfaces with the area of operations through contact with the ALF, support will frequently be provided directly to the CCF, bypassing intermediate echelons.

4.1.5 Logistics Operations in the ALF. ALF logistics support will be centrally managed with decentralized execution. Supplies will be automatically pushed forward from a Regimental Support Force (RSF) based on a combination of predictive models and an automated expenditure reporting system. Logistics support will be characterized as follows:

4.1.5.1 Reconstitution: Sustainment of unit combat effectiveness will be accomplished through reconstitution operations in the ALF area of operations. Reconstitution is the support that restores a unit's combat effectiveness through the replacement of expended supplies, repair and/or replacement of vehicles and weapon systems and personnel. Reconstitution is composed of either of two operations: replenishment and regeneration.

a. Replenishment: Replenishment is the process of sustaining readiness and operational capabilities through the issue of supplies/equipment at predetermined intervals. Replenishment operations for ammunition support will consist of the routine resupply of ammunition to the Regimental Support Force (RSF) to maintain the regimental basic load (estimated 3 to 5 days) on an as-needed basis. The Ammunition Reconfiguration Module

(ARM) will configure and package the ammunition based on requirements furnished by the Regimental Support Force. When the tactical situation allows, the ALF Support Command transportation assets will deliver this ammunition to the Regimental Support Force and retrograde any residue to the ARM. When the regiment is operating deeper in the IBA, such that ALF CSS vehicles cannot move to the Regimental Support Force, then the RSF, with combat force escort if required, will move back to rendezvous with the ALF CSS elements at a reconstitution site.

b. Regeneration: Regeneration is the process of rapidly restoring a unit's mission capability after a severe degradation of supplies, equipment, and/or personnel due to enemy action. Massive infusion of supplies, equipment, weapons systems and personnel is accomplished at a reconstitution site located in a secure rendezvous area. The concept calls for the regiment to move to the reconstitution site and be brought up to a state of combat readiness within a period of 45 minutes.

Note: This report will focus on the replenishment aspects of reconstitution and will NOT attempt to quantify or analyze any aspect of regeneration.

4.1.6 Class V Resupply - Current vs. Division 86 vs. Army 21. Perhaps the best way to understand ammunition resupply for Army 21 is to highlight the differences between today's systems, the changes visualized for the Division 86 timeframe, and those visualized for support of Army 21.

4.1.6.1 Current System. Figure 3 is a schematic of the

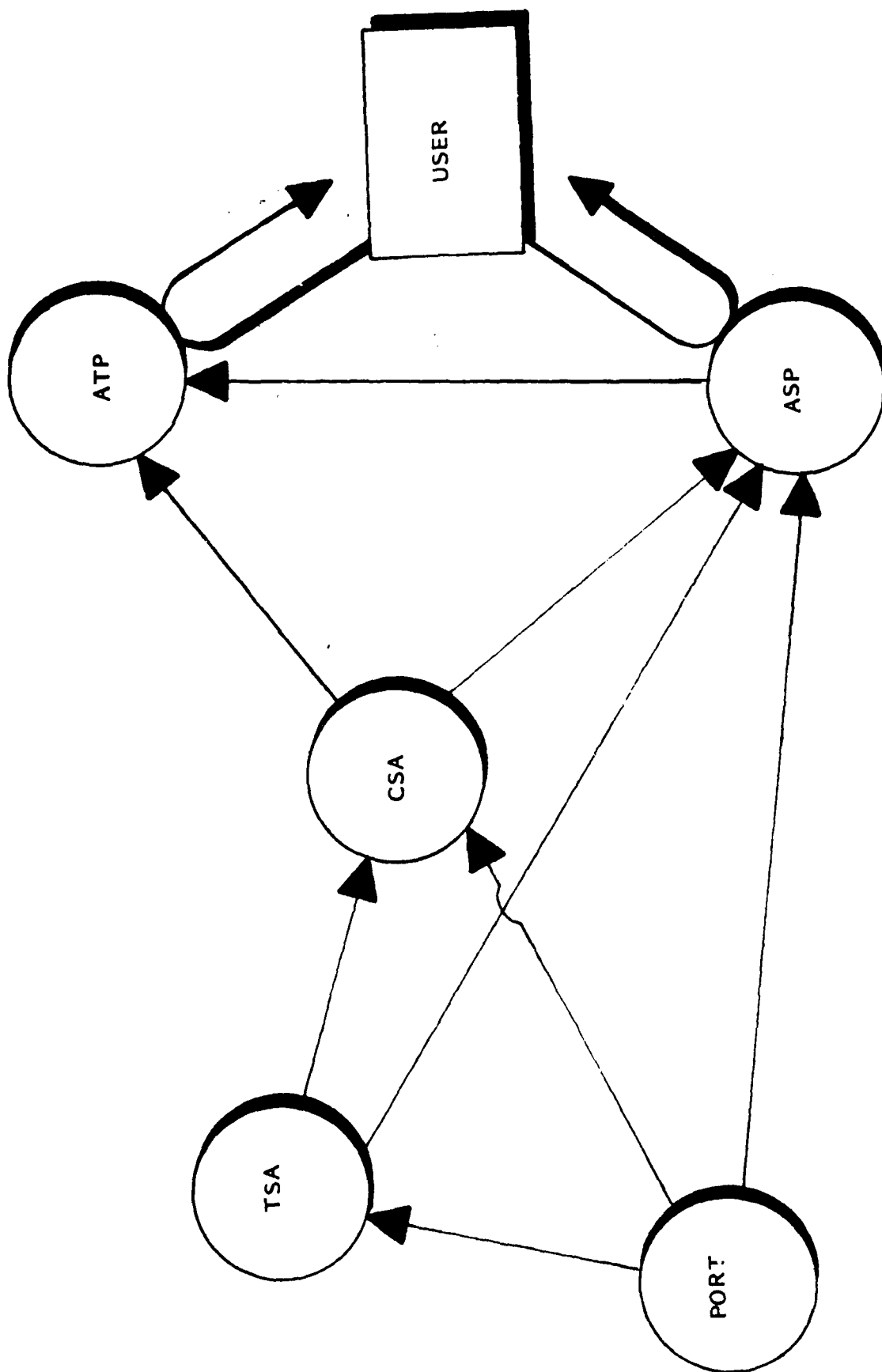


Figure 3. Schematic of the current OCONUS Ammunition Resupply System.

current Class V resupply system for an overseas theater. The largest amount of ammunition comes into the theater via a seaport; however, some circumstances may dictate the use of aerial ports. Operation of the ports and the movement of ammunition to the theater storage area is a transportation function and remains under the control of the transportation system until it reaches its destination as indicated on the movement document.

a. Theater Storage Area: The first element of the Ammunition Resupply System is the theater storage area (TSA). The TSA operation may use permanent facilities if available, but will also have a capability to ground and store containers of ammunition. The ammunition companies are equipped with 4000 and 6000 lb Rough Terrain Fork Lifts (RTFLs), 20 ton cranes, 50,000 lb Rough Terrain Container Handlers (RTCHs) and mobile ramps. The companies are under the control of an ammunition battalion.

b. Corps Ammunition Storage Area. Ammunition is moved forward from the theater storage area to the corps storage area (CSA) via line-haul transportation units. If available, rail lines and/or barges would be used. The ammunition is either grounded in containers, stored in the open or placed in magazines if available. This is a large storage site, generally static with little mobility. The corps storage area provides ammunition to ammunition supply points (ASPs) and/or directly to ammunition transfer points (ATPs).

c. Ammunition Supply Point (ASP). Ammunition is called forward from corps storage areas to ASPs and is moved by

corps transport vehicles. Currently, containers received at the ASP are not grounded but remain on trailers until the ammunition is removed. Although somewhat smaller in size than a corps or theater storage area, the ASP located to the rear of the division area is relatively large with 3 to 5 days of ammunition grounded generally in open areas. The operation is labor intensive with heavy reliance on manpower and limited materials handling equipment (MHE) to accomplish the mission. With an augmented TO&E, one ammunition company is capable of operating two ASPs. Each ASP is capable of handling 1000 short tons per day (500 tons in and 500 tons out).

d. Ammunition Transfer Point (ATP). The ATP is located further forward in the brigade support area. As the name implies, these are not storage locations but rather designated temporary sites where ammunition is transferred from corps transportation trailers to user tactical vehicles. The ATPs are equipped with the 6,000 lb. RTFL and the 7 1/2 ton crane with a "doctrinal capability" of transferring 500 short tons of ammunition per day. [In actual practice a current estimate is 300 short tons (ST) per 24 hour period.] The number of trailers in an ATP at any one time is small (12-15) in order to minimize its battlefield signature and to permit rapid movement. Only high tonnage, high-usage munitions are transferred to the user at an ATP location.

e. Ammunition User--The Maneuver Unit. The combat maneuver battalion is the final link in the ammunition resupply system. If it needs a high tonnage item, it will go to the ATP,

otherwise it goes to an ASP.

4.1.6.2 Ammunition Resupply - Division 86 Timeframe.

Changes in the movement of ammunition from the port to the corps storage area and forward to a resupply site (ASP or ATP) will be characterized by the introduction of improved (semi-automated and automated) MHE and container off-loading equipment at the port; increased utilization of containers for the movement of ammunition from the CONUS wholesale depots up to the Ammunition Reconfiguration Module (ARM) (which will replace today's Ammunition Supply Point (ASP), during the Division 86 timeframe); and replacement of 22 1/2 ton S & P trailers with 34 ton S & P trailers. The user 5 ton and GOER vehicles will be replaced by the 10 ton Heavy, Expanded Mobility Tactical Truck (HEMTT) for transport of ammunition from the ARM and ATPs to the battalion trains where they will interface with the Field Artillery Ammunition Supply Vehicle (FAASV) and the Tracked Combat Service Support Vehicle (TCSSV). The ASP will gradually be phased into the ARM as the BRASS concept develops. The ARM is a highly automated, mobile unit equipped with robotic devices for unloading, sorting and repackaging ammunition in a bare round configuration, and loading of ammunition on user trucks. The ARM will have only 6 to 12 hours of ammunition at any one time. It will offer other advantages of higher productivity, will be less manpower intensive, and will be more mobile with a reduced target signature. Maneuver battalion unit vehicles will continue to return to the ARM for resupply; however, the ammunition will be

prepackaged in Ready-round Ammunition Containers (RACs) in a form readily useable by the unit. Ammunition issue at the ARM will be accomplished in a fraction of the time required in the current system. Note: For a detailed description of the ARM, see ASI Report "BRASS 2000" and supporting BRASS briefing slides.

In this regard, the reader must understand that Division 86 is a transition period between today's Army and Army 21. This transition will extend up through the 1995 period and perhaps the end of the century. Many of the changes and improvements in the automation of handling equipment and enhanced communications may not materialize until the latter part of the Division 86 timeframe.

Figure 4 is a micro flow chart of the interface events between the general support Class V units and the user units for this timeframe. One major change over the current system is the improved communications. The events depicted in Figure 4 are based on the successful fielding of the "Mobile Subscriber System" (MSS), sometimes referred to as "Ma Bell in the field". Under the current system, the ASP is not aware of user requirements until the unit convoy reaches the ASP office and the convoy commander presents a hard copy of his Ammunition Request, DA Form 581, which requires an average of 65 minutes to process. Add to this an additional 45 to 90 minutes, depending on the size of the convoy, for each unit vehicle to make a serpentine route through the ASP, stopping at each field storage unit (FSU) or ammunition stack

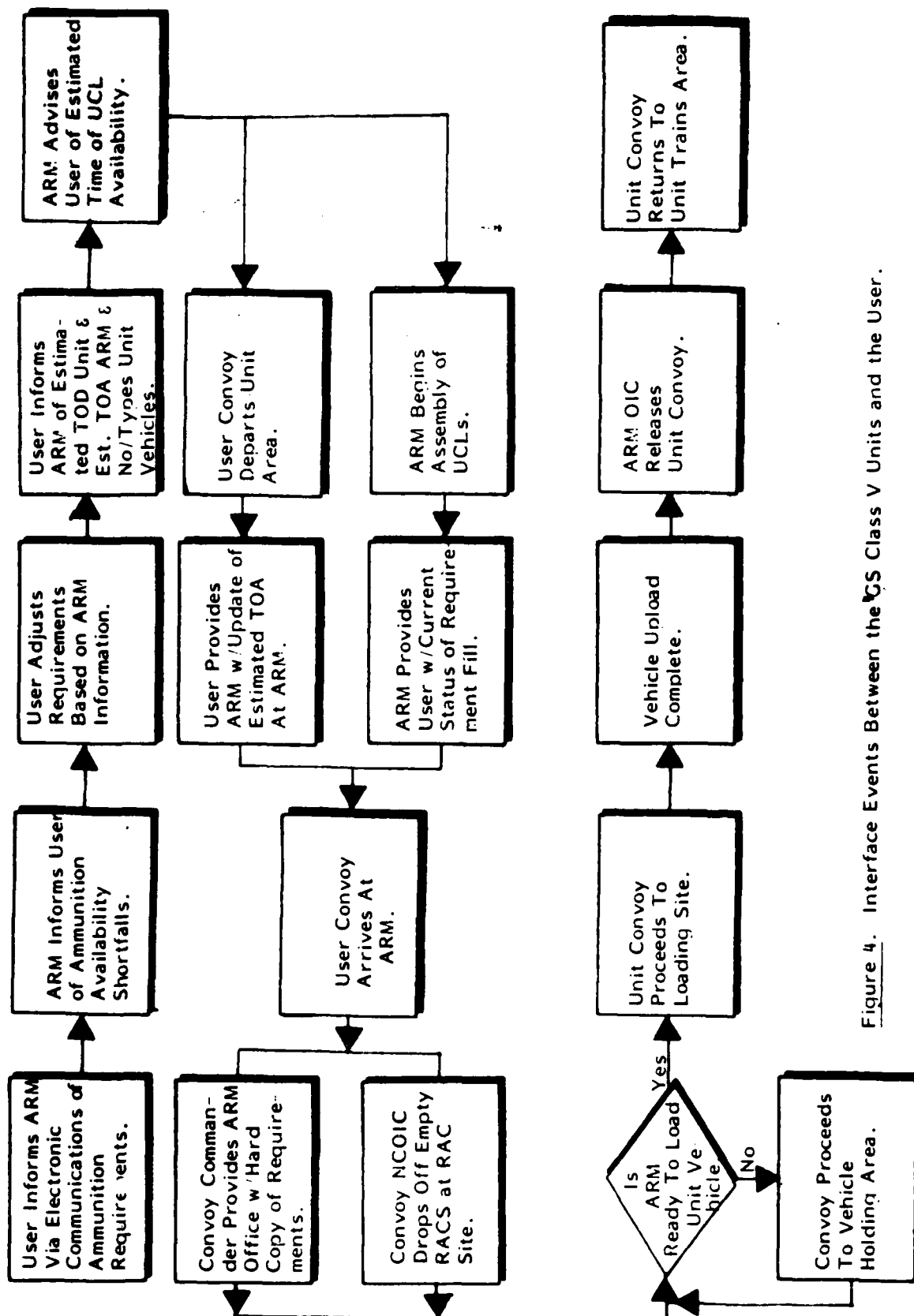


Figure 4. Interface Events Between the CS Class V Units and the User.

containing the type of ammunition required by the requisition, and the shortcomings of the current system become quite clear. As shown in the Division 86 event flow diagram, the user using the MSS, informs the ASP/ARM of its requirements prior to departing the unit area so that when the unit convoy arrives at the ASP/ARM, the convoy commander simply provides a hard copy verification of his ammunition requirements to the ARM officer-in-charge (OIC). As indicated above, his requisition has already been filled and his ammunition has been prepackaged in user friendly packaging and arranged in vehicle loads (based on types of vehicles the user has in his convoy), ready for rapid uploading. The entire operation from arrival of the user vehicle convoy at the ASP/ARM to uploading with required ammunition and departure from the ASP/ARM for return to the unit area is accomplished in less than an hour.

4.1.6.3 Ammunition Resupply - Army 21 Timeframe. The fundamental or basic flow of ammunition in the Army 21 timeframe from the port up to the ARM will not be much different than that described for Division 86 with the following exceptions:

- a. Increased use of ISO containers with slip sheets for the rapid unloading of ammunition at the ARM.
- b. Further automation of MHE through the use of robotic technology.
- c. Increased use of smart or intelligent munitions with special packaging and handling requirements.
- d. Introduction of large caliber ammunition magazines for tanks and howitzers for automatic loading and

increased rates of fire.

e. Improved communications and automatic data processing that will permit automation of ammunition expenditure reporting to provide resupply operations predicted on reports from regimental support units. The reports will be consolidated at the regimental level and forwarded to the ALFSCOM (Airland Force Support Command).

The greatest change, however, will be the concept for ammunition resupply from the ARM forward. As shown in Figure 5, the Regimental Support Force (RSF) in combination with regimental support force forward support units (the battalion trains) and the maneuver battalion fighting vehicle will collectively maintain a 3 to 5 day supply of ammunition. The maneuver battalion unit vehicles will not return to the ARM or ATP every 6, 12 or 24 hours for resupply. For the routine resupply, the maneuver battalions armored ammunition resupply vehicles (TCSSVs and FAASVs) will be resupplied from stocks in the Regimental Forward Support Area (RFSA). Typically, the 1/3 rule is followed, i.e., when 1/3 of the armored resupply vehicles' ammunition load has been transferred to the firing elements (weapons) they are resupplied as far forward as possible by the RFSA trucks. Likewise, when 1/3 of the RFSA ammunition vehicles have been emptied, they return to the RSF main support unit supply or are replenished by the ALFSCOM. The RSF main support unit ammunition resupply vehicles in turn, return to the ASP/ARM or ATP for ammunition resupply, if the tactical situation permits.

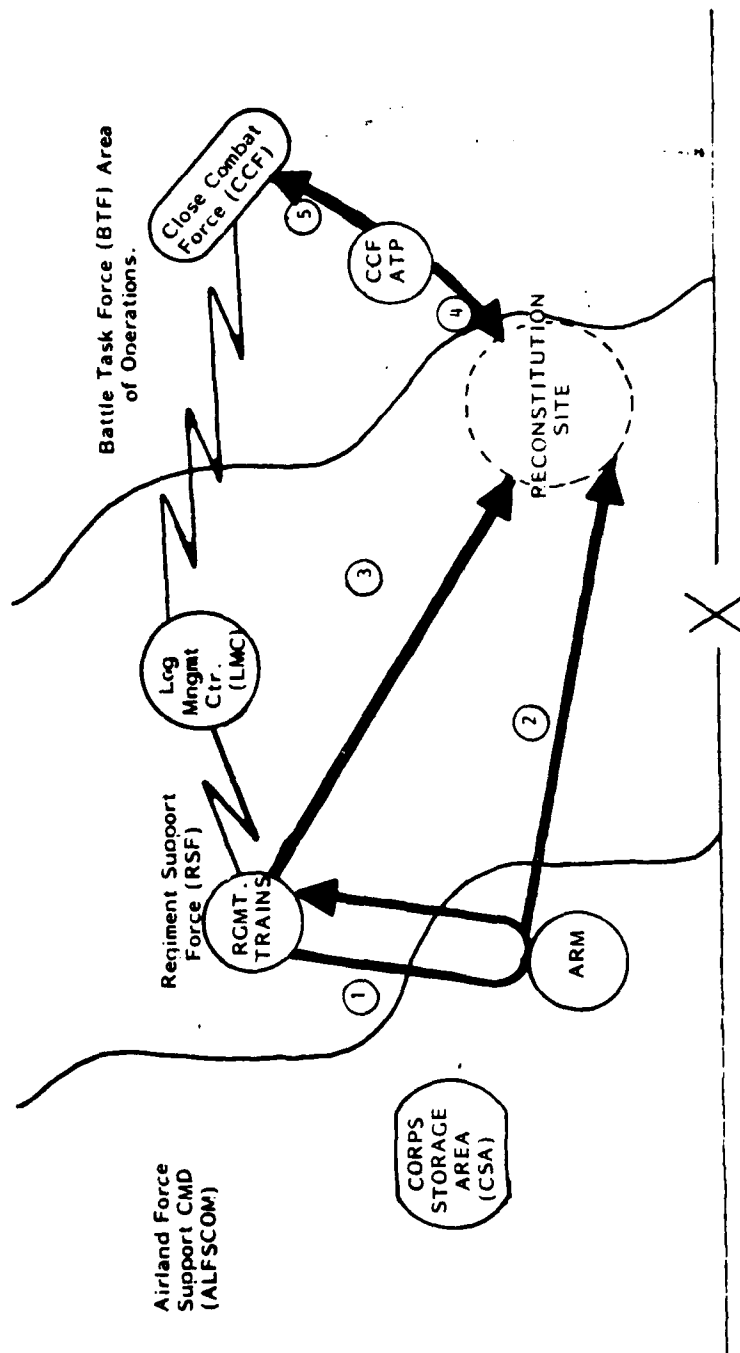


Figure 5. Army 21 Class V Resupply--ARM Forward to CCF.

If the tactical situation is such that the RSF main ammunition vehicles cannot return routinely to the ASP/ARM or ATP for ammunition resupply, then the regiment continues to fight until the bulk of the ammunition contained on the fighting vehicles, and their armored support vehicles, and RSF ammunition support vehicles is consumed. The ARM configures and replenishes the RSFs ammunition stocks based on requirements supplied to the Logistics Management Center (LMC) by the RSF. ALFSCOM transportation assets deliver this ammunition from the ARM to the RSF and retrogrades any residue. This may require the regiment to move to a reconstitution site to rendezvous with the ALFSCOM convoy.

(Note: If the regiment has been decimated and can no longer perform its mission, the regiment rendezvous at a secure area (regeneration site) with elements of the ALFSCOM which provide personnel, supplies and equipment necessary to return the unit to a combat capable condition. However, regeneration of the regiment is beyond the scope of this report.)

The type and quantity of ammunition required to resupply the regiment is determined by the LMC, based on information provided by automatic expenditure reports and the staff sections of the RSF. The LMC provides the ARM (via direct computer data links) with a packing and loading manifest for an Ammunition Unit Configured Load (UCL) which replenishes the basic load of the unit being resupplied. The ARM configures, packages, and loads the required stocks aboard ALFSCOM transportation for delivery to the

required stocks aboard ALFSCOM transportation for delivery to the reconstitution site.

4.1.7 Impact of Army 21 Concept on BRASS. In many ways, BRASS will be very compatible with the Army 21 concept particularly the repackaging of ammunition in a more useable form and the pre-assembly of UCLs. Depending on how often it is planned to resupply the RSF, it may be necessary to assemble a larger quantity of ammunition at the ARM than visualized for the Division 86 timeframe, depending on whether or not the ALF transportation assets will be picking up larger quantities at one time for movement to a reconstitution site or whether the pickup will be phased with the output of the ARM.

In summary, Army 21 has removed the Division Support Command (DISCOM) from the structure and replaced it with a Regimental Support Force (RSF). For routine resupply, rather than have the maneuver battalion's ammunition supply vehicles returning to the ASP/ARM or ATP for replenishment (since the maneuver battalion no longer has any organic ammunition resupply vehicles), the RSF ammunition resupply vehicles return to the ASP/ARM or ATP and transport the ammunition forward to the battle area where they interface with and replenish the maneuver battalions. As indicated earlier, if the tactical situation is such that the RSF ammunition vehicles are unable to routinely return to the ASP/ARM or ATP for resupply, then the regiment continues to fight until the bulk of the ammunition contained in the fighting vehicles, the armored resupply vehicles and the RSF ammunition vehicles is consumed. The

RSP vehicles then return to a reconstitution site located in a safe area for replenishment of their 3-5 days of supplies. Some tactical forces may accompany this relatively large vehicle convoy to the reconstitution site to provide protection from enemy forces (see Figure 5).

4.2 Resource Requirements to Support One Division 86.

This section addresses subparagraph 4 of Task #1 of the TRANSLOG contract. This subtask requires an estimate of the number of ARMs that are required to support the committed brigades of a division, assuming each brigade consumes 1,000 short tons of ammunition in a 24-hour period. In addition to estimating the number of ARMs required, the subtask requires an estimate of the general support (GS) transportation requirements, ARM throughput requirements and the user transportation requirements. Lastly, it requires an estimate of the reconstitution time for each brigade, assuming a conventional battlefield.

Based on discussions with the HEL technical representative, it was decided that the focus for this subtask would be on the Division 86 (J series TO&E) heavy armored and mechanized divisions. In order to establish a starting point, the extract of the "Echelons Above Corps Study (1980) Expenditures" provided by the Missile and Munitions Center and School (MMCS) to the HEL and ASI in February 1984 was used. This extract states that both the heavy armored and mechanized J series divisions will each expend 4545 short tons of ammunition per 24-hours. Also, either of these divisions would be supported by a total of four

ammunition transfer points (ATPs). Three of the ATPs would each issue 300 short tons per day each to each of the committed brigades for a total of 900 short tons. The fourth ATP will issue 150 short tons per day to other division units.

The next base line piece of information that was required for this subtask was also provided by the Missile and Munition Center and School (MMCS) in February 1984. This is an extract which shows the flow of ammunition by total tonnage and percentage of tonnage for a typical Corps 86. This is shown in Figure 6. The key items of information from Figure 6 are that the (ATP) receives 20% of its ammunition from the ASP and 80% from the CSA. Additionally, the other key item is the input of ammunition into the ASP/ARM. Fifty percent comes from the CSA, 30% from the TSA, and the final 20% comes directly from the port.

In trying to distribute this ammunition resupply system over a division the following assumptions were made:

- All three of the brigades of the division are committed.
- Each brigade consumes an average of 1,000 short tons per day.
- It is desirable to balance the workload in each ASP/ARM.
- Each brigade will only use one ASP/ARM and one ATP.
- Other divisional units will use all four ASP/ARMs but

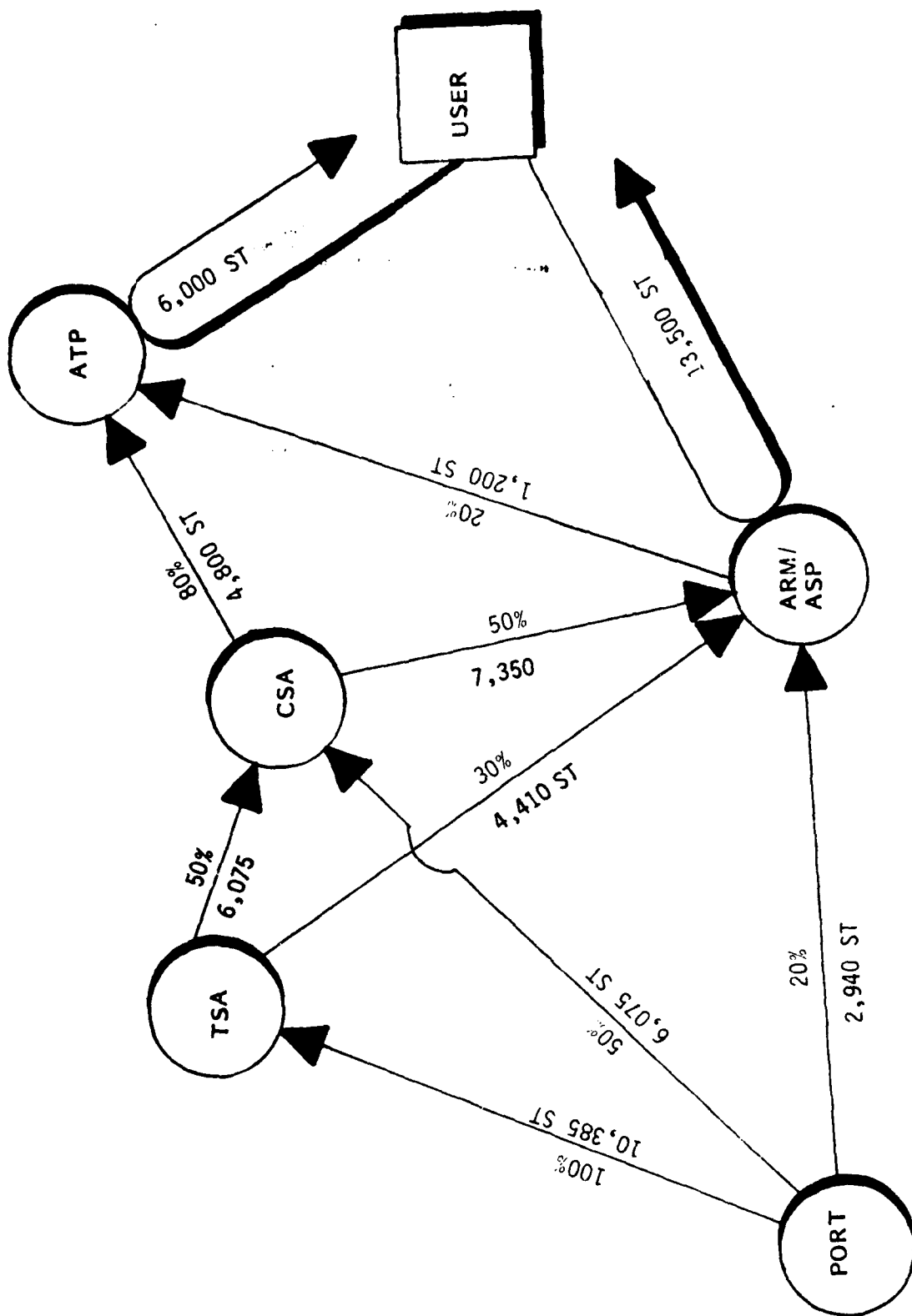


Figure 6. Typical Corps 86 Ammunition Flow Rates.

only the one ATP that issues 150 short tons per day.

These assumptions seem both reasonable and valid and are necessary in order to establish a balance in the framework from which to start making the estimates that are required in this subtask.

In establishing the workload/throughput for these various ammunition distribution points, ASI started by looking at the three ammunition transfer points that supported each of the three committed brigades. As shown in Figure 7, these ammunition transfer points each issue 300 short tons per day. These 300 short tons are received partially from a supporting ASP/ARM and partially from the CSA. The ASP/ARM provides 20% or a total of 60 short tons per day and the balance of 240 short tons is received from the CSA. The fourth ammunition transfer point (that issues 150 short tons per day) receives 80% of its ammunition (120 short tons) directly from the CSA and the balance of 30 short tons from the fourth ASP/ARM.

Therefore, in looking at the workload associated with each ASP/ARM, and keeping in mind that a goal is to balance the workload in the ASP/ARM, it was determined that:

- Each of the three ASP/ARMS that support a committed brigade will issue a total of 926 short tons per day. This is broken down as follows:

- 700 short tons go to the committed brigade that the ASP/ARM is supporting.

- 60 short tons go to the ATP that is supporting

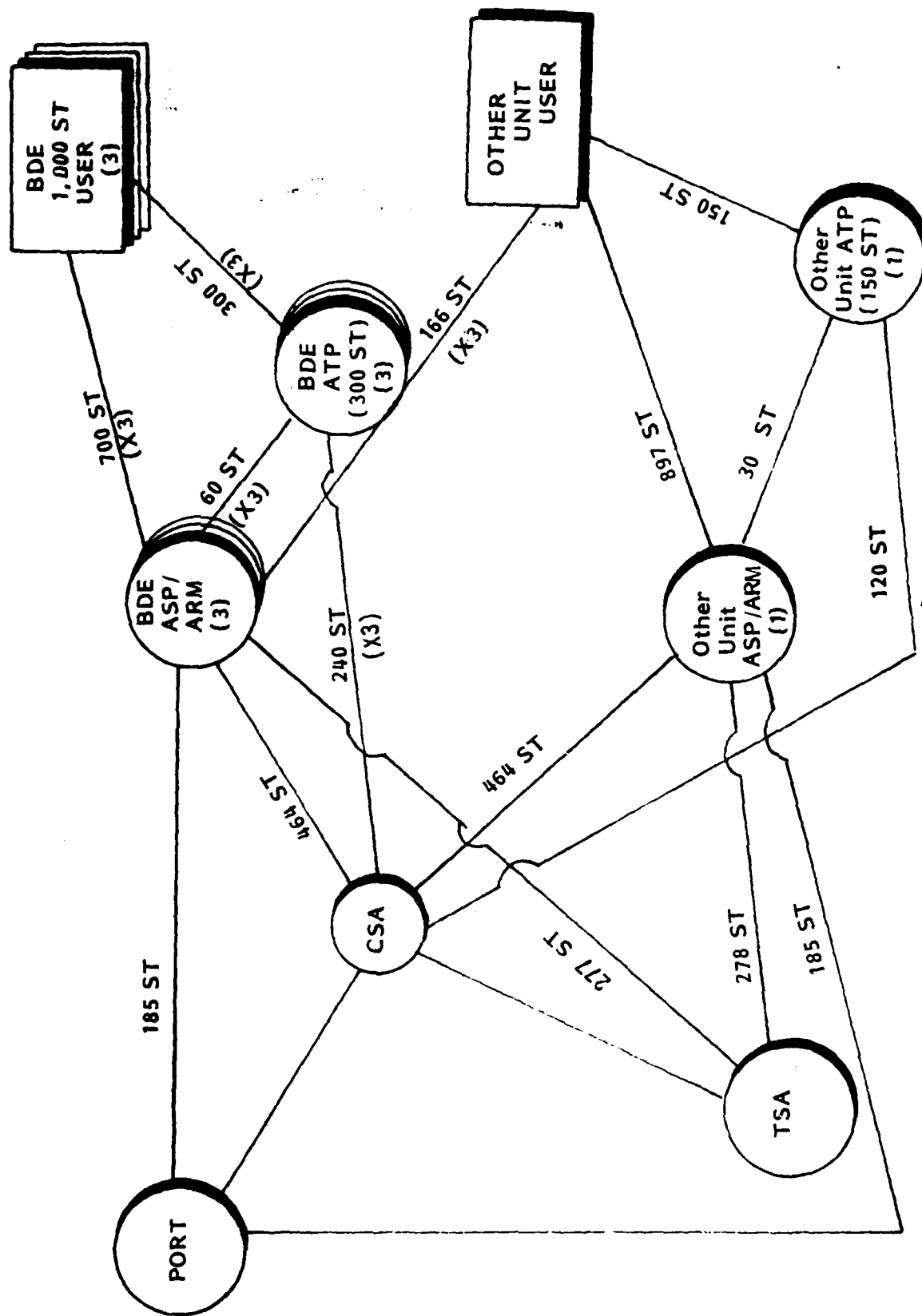


Figure 7. Ammunition tonnage flow for a Division 86 Heavy Armored or Mechanized Division.

that brigade.

●● 166 short tons are available for other division units that are located in the vicinity of the ASP/ARM.

● The fourth ASP/ARM will issue 927 short tons per day. This will break down as follows:

●● 897 short tons per day will be available for other division units (not part of the committed brigades).

●● 30 short tons per day will be sent forward to the ATP that issues 150 short tons per day.

Based on this scheme, each of the four ASP/ARMS will have a reasonably balanced work load of issuing approximately 926 short tons per day. The total for the division is as follows:

3 each ATPs (one per brigade) issue 300 ST/day = 900 ST

3 each ASP/ARMS (one per brigade) issue

866 ST/day = 2598 ST

(700 ST go to the brigade and 166 ST

go to other division units. Each ASP/ARM

also issues 60/day to the brigade ATP.)

1 each ATP issues 150 ST/day to other

divisional units = 150 ST

1 each ASP/ARM issues 897 ST/day to other

divisional units = 897 ST

(This ASP/ARM also issues 30 ST/day to

4th ATP.)

TOTAL = 4545 ST

It should be noted that there are obviously many other methods of distributing the 4545 ST/day throughout the division. The above detailed scheme is one way of accomplishing the task. However, this scheme tends to balance the workload in each of the ASP/ARMS throughout the division area and will be used for the remaining analysis within this subtask.

4.3 Reconstitution of A Regiment.

4.3.1 General. The resupply and transportation requirements for the reconstitution (replenishment) of a committed brigade are addressed in the section. For the purpose of consistency with stated concepts and terminology and for uniformity within this report, a Division 86 brigade operating under the postulated Army 21 concept is replenished at a reconstitution site.

4.3.2 Parameters and Conditions. Due to the unavailability of a notional Army 21 brigade, a notional Army 21 regiment was utilized. The composition of this mechanized infantry regiment is shown in Figure 8.

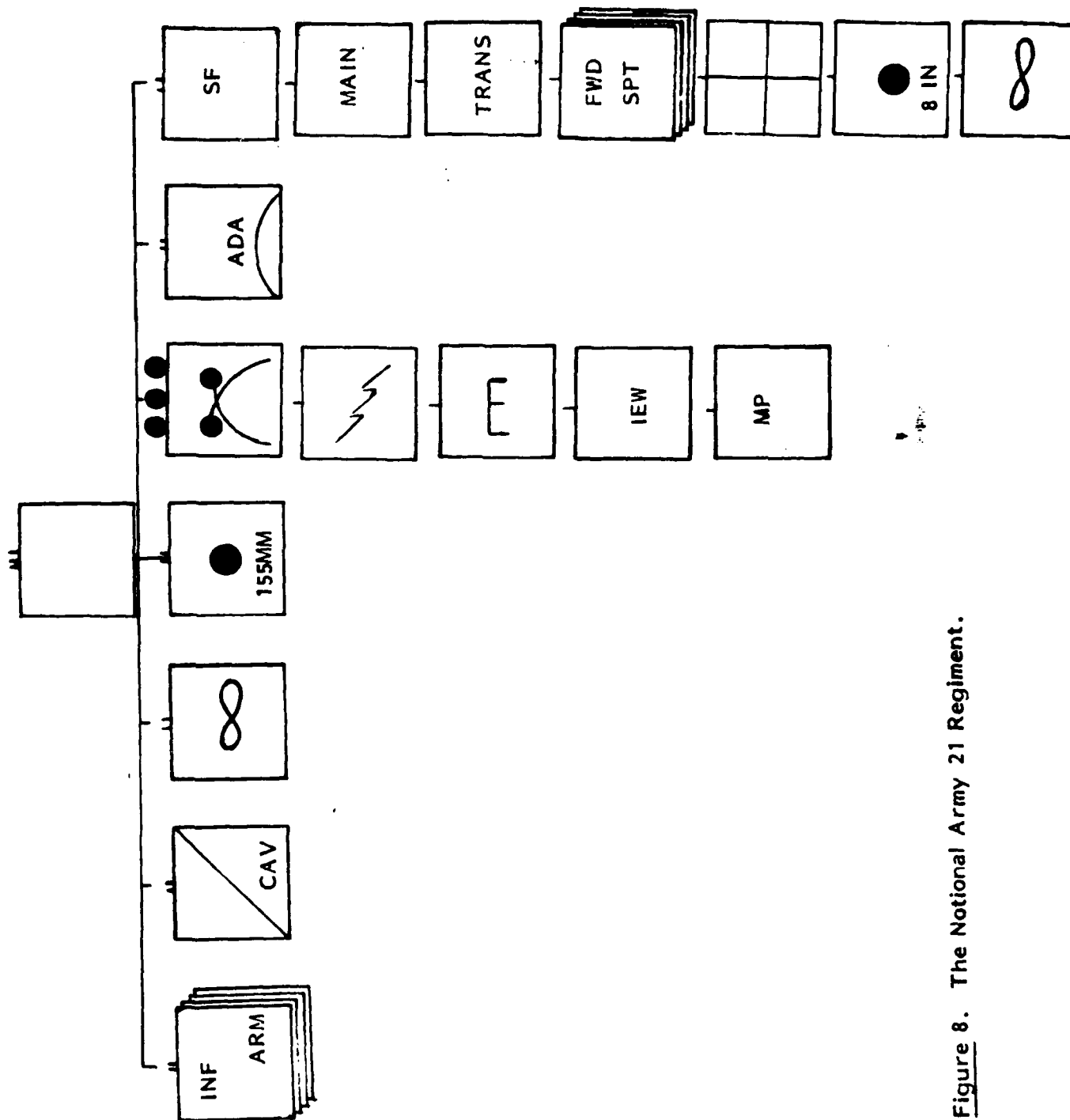


Figure 8. The National Army 21 Regiment.

Appendix A, Unit Reference Data, lists the units within the regiment. FM 101-10-1 (Staff Officer's Field Manual: Organizational, Technical, and Logistic Data), was used to compute requirements. Planning factors for units within the regiment were correlated to like units listed under the mechanized infantry division. In some cases the equivalent unit was determined by approximation, using the mission descriptions in FM 101-10-1. For those few units which had no equivalent in the mechanized division, a similar unit was selected from another type division and the mechanized factor was considered to be minor. Two of the units, the electronic warfare company and the chemical platoon, were not included in FM 101-10-1. Their requirements were considered to be insignificant.

4.3.3 Scenario Sketch.

4.3.3.1 Assumptions.

a. The Regimental Support Force (RSF) vehicles are 90% empty and the regiment requires four days of resupply of Classes I (to include water), III and V to replenish to a level of five full days of supply of the specified classes. (Note: The regiment will obviously have requirements for all classes of supply; however, this report is restricted to Classes I, III, and V.)

b. The maneuver battalions' combat vehicles have a full load and a portion of the "battalion trains" (RSF Forward Support Units) remain in place for resupply of the maneuver battalions during the replenishment operation.

c. The regiment has 6000 personnel.

d. Movement (travel) will average 100 kilometers per day.

e. The regiment will expend 1000 short tons of ammunition per day.

4.3.3.2 Situation. Using the reconstitution concept, the RSF "fights" its way back to a reconstitution site for replenishment. The site designated is approximately 25 kilometers from the regiment's area of engagement.

The replenishment convoy from the Airland Force Support Command (ALFSCOM) rendezvouses with the RSF at the reconstitution site and the resupplies are transloaded. See paragraphs 4.3.6 and 4.3.7 for a discussion of convoy factors, transloading considerations and specific problem areas.

4.3.4 Replenishment Requirements

Appendix B, Replenishment Requirements, provides the Class I, III and V requirements for the regiment for one through five days. The Office of the Deputy Chief of Staff for the Logistics (ODCSLOG), DA, computations for a three day replenishment of a Division 86 mechanized infantry brigade are about the same for dry cargo. Wet cargo computations in this report are about 40% less than those of ODCSLOG.

	<u>DCSLOG COMPUTATIONS</u>	<u>THIS REPORT</u>
Dry Cargo	4,012 Short Tons	3,966 Short Tons
Wet Cargo	536,555 Gallons	306,531 Gallons

The DCSLOG totals are based on FM 101-10-1 planning factors; however, specific parameters used in the DCSLOG computations were not available. Certain factors significantly influence required quantities. For example, an increase of 50 kilometers in the daily displacement would increase the three-day wet cargo requirement from 306,531 gallons to 366,161 gallons (this is caused by a 50% increase in MOGAS and diesel fuel). Factors used to compute dry cargo totals are time dependent and therefore are more stable. Fuel consumption is highly sensitive to distances involved in unit displacement. Current Army 21 concepts espouse the possibility of unit displacement being as high as 300 kilometers per twenty-four hour period.

4.3.5 Transportation Requirements. For a four day replenishment, the transportation of the following quantities is required:

a. Dry Cargo -

Rations	- 1,288 Short Tons
Ammunition	- <u>4,000 Short Tons</u>
Total	- 5,288 Short Tons

b. Wet Cargo -

Water	- 96,000 Gallons
Fuel	- <u>312,708 Gallons</u>
Total	- 408,708 Gallons

Vehicle Load Capacities

a. Dry Cargo: 10 Ton, Heavy, Expanded Mobility
Tactical Truck (HEMTT)

b. Wet Cargo: "

(1) Water: M50A2 Tank Truck with an M149A1 trailer
- 1400 gallons.

(2) Fuel: M559 (HEMTT) Tank Truck with a 500 gallon
trailer - 3000 gallons.

Vehicle Requirements

a. Dry Cargo -
Rations - 129 10 Ton Trucks
Ammunition - 400 10 Ton Trucks
Total - 529 10 Ton Trucks

b. Wet Cargo -
Water - 69 Tank Trucks w/Trlrs
Fuel - 105 Tank Trucks w/Trlrs
Total - 174 Tank Trucks w/Trlrs

c. The utilization of different types of vehicles
would, of course, effect total vehicle requirements. Figures 9
through 12 show various transportation options and vehicle
requirements. Follow-on discussions in this section will be based
upon the vehicle requirements specified above for a four day
replenishment.

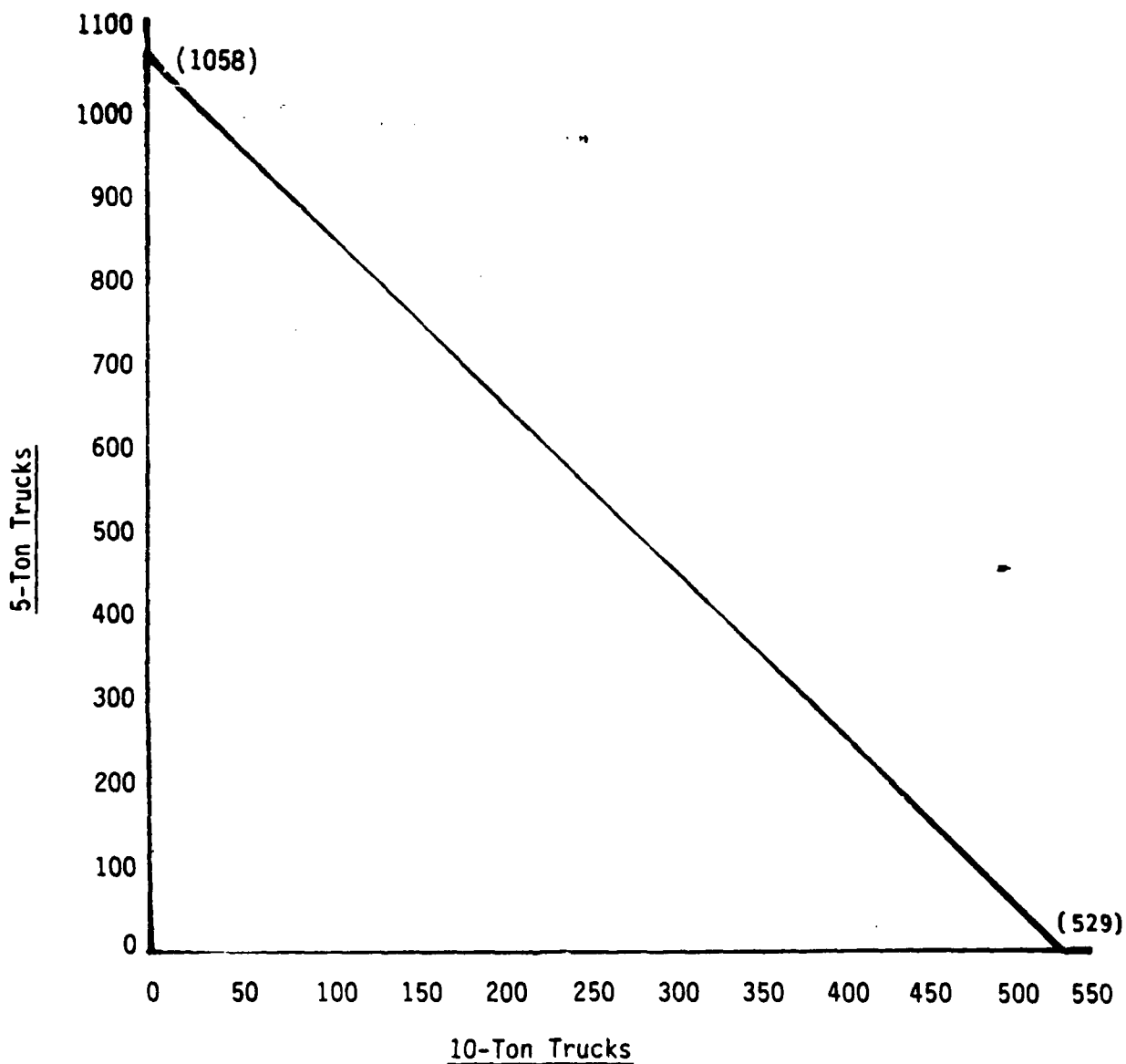


Figure 9. Dry Cargo Transportation Requirements (5-ton and 10-ton trucks).

Mechanized Infantry Regiment
Four Day Replenishment (Class I and V): 5,288 short tons

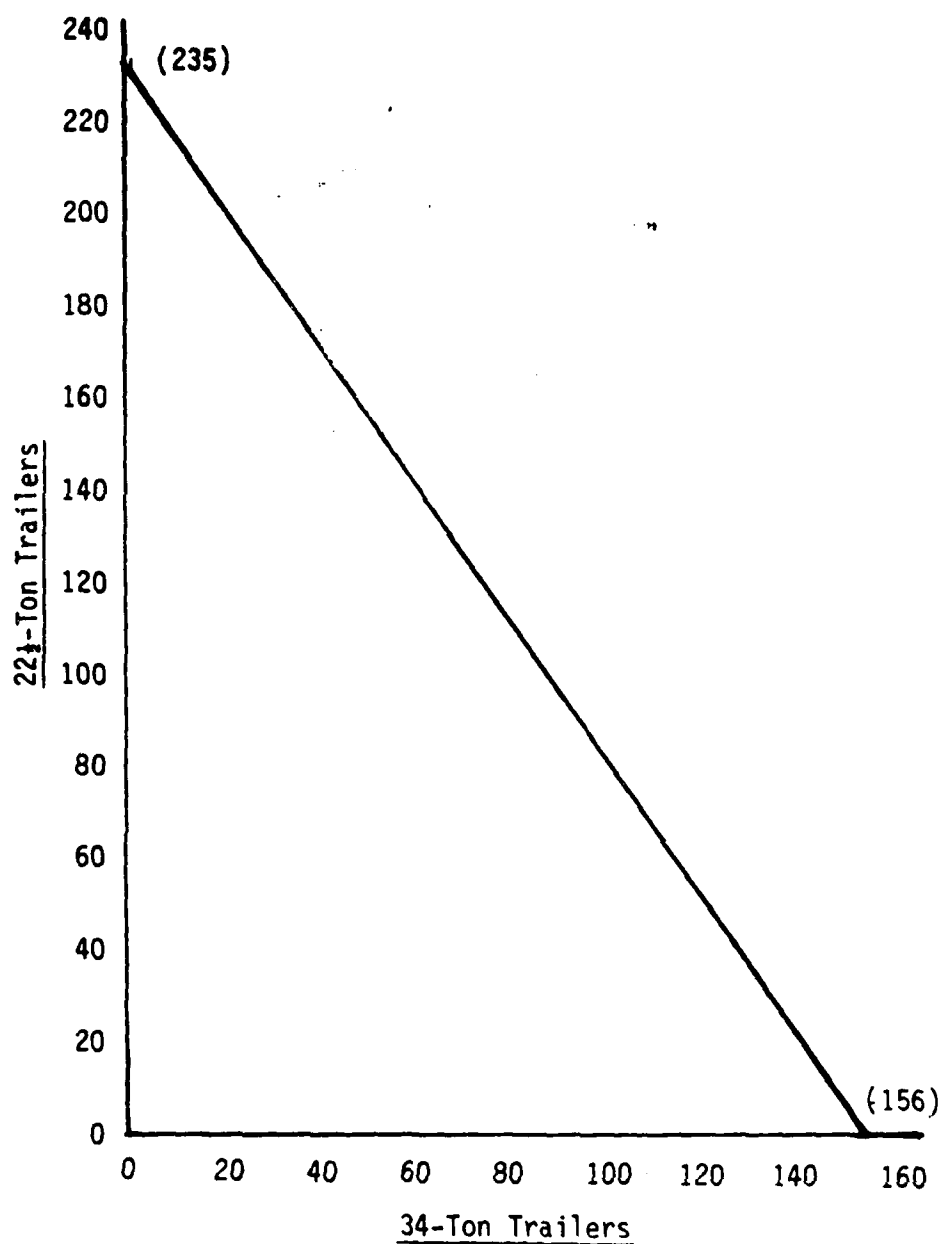


Figure 10. Dry Cargo Transportation Requirements (General Support 22 1/2-ton and 34-ton trailers).

Mechanized Infantry Regiment
Four Day Replenishment (Class I and V): 5,288 short tons

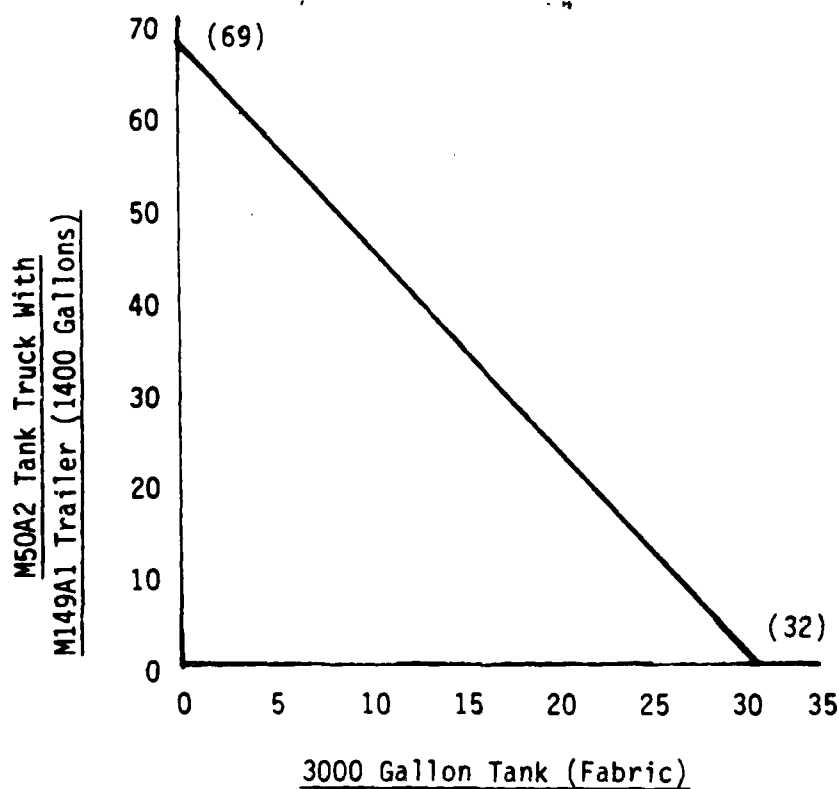


Figure 11. Water Transportation Requirements (M50A2 tank truck and 3000 gallon fabric tank).

Mechanized Infantry Regiment
Four Day Replenishment = 96,000 gallons

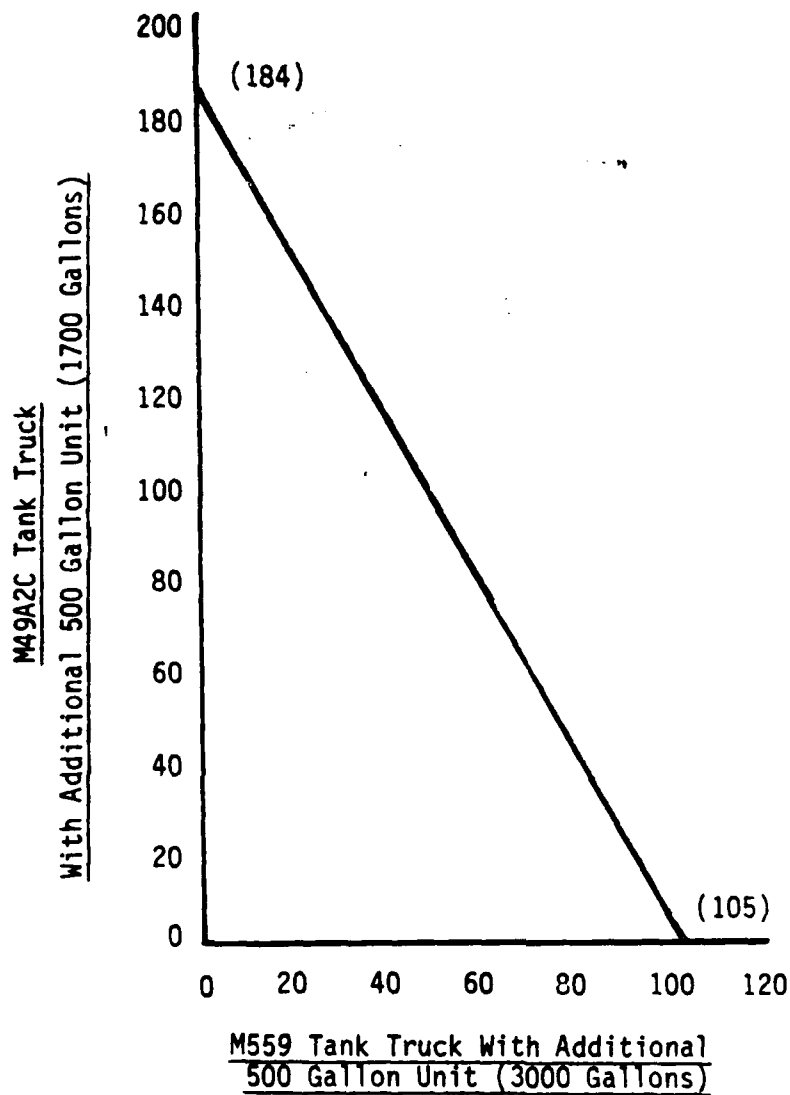


Figure 12. Fuel Transportation Requirements (M49A2C Tank Truck and M559 Tank Truck).

Mechanized Infantry Regiment
Four Day Replenishment: 312,708 gallons.

4.3.6 Convoy Composition. A convoy composed of 529 10 ton trucks and 174 tank trucks with trailers would: measure approximately 50 miles in length, on the move; at a convoy speed of 16 mph and at a vehicle interval of 100 meters would take over three hours to pass a given point; and would have a bumper to bumper length of about five miles. The control and security of such a convoy are, at best, questionable under any conditions. Under Army 21, it presents a situation that will, in most cases, be highly vulnerable.

A more realistic approach would be to use smaller convoys and several reconstitution "points" within a reconstitution site. One method would be to designate separate convoys for each of the following: a maneuver battalion; an artillery battalion, a heavy artillery battery (8" Howitzer); the RSF; an armored cavalry squadron, an aviation battalion; and all other regimental units to include the headquarters and headquarters company. The notional mechanized infantry regiment in this study would then be replenished at nine "points" by nine separate convoys. The number of convoys and points could be reduced to seven by combining the two mechanized infantry battalions and by combining the howitzer battery with "all other" regimental units. The armored cavalry squadron and aviation battalion are kept separate because of their high requirements for fuel in the forward area (Unit dispersion under the Army 21 concept suggests the employment of Forward Area Rearm/Refuel Points (FARP) to support a regiment/brigade. A detailed discussion of the FARP is contained in the ASI Report

"Analysis of Helicopter Rearm/Refuel Logistics Operations", B.M. Davall and D.J. Shearin, October 1982).

In employing seven convoys, the time and space factors would be reduced to (on an average):

Length of convoy on the move:	7.0 miles
Time to pass a given point:	27.0 minutes
Length of convoy bumper to bumper:	0.7 miles

Despite the reduction, the convoy time and space factors are still significant.

4.3.7 Cargo Transfer at the Replenishment Site

The transfer could be accomplished by: trading empty RSF vehicles for loaded ALFSCOM vehicles; transloading the cargo from ALFSCOM vehicles to RSF vehicles; or through a combination of trading and transloading. Vehicles assets, transload time requirements, and liquid cargo transfer methods introduce problems which cast serious doubt upon the ability to rapidly replenish a regiment.

A regimental replenishment convoy of 703 vehicles plus trailers would take over two hours to arrive at the site, i.e., from arrival of first vehicle to arrival of last vehicle. Cargo carrying assets within the RSF would have to be equal to the cargo aboard the 703 ALFSCOM vehicles and trailers. Transloading the rations and ammunition at the rate of two minutes per pallet (or 1 short ton) with an ideal 10 ton HEMTT load of 10 pallets would take twenty minutes if every HEMTT had an onboard crane. The transfer of liquid cargo presents other problems. The RSF

"receiving" containers and the rate of water and fuel transfer are problem areas that are difficult to address. Water may be locally available and might not be a problem; however, for fuel, at the rate of 300 gallons per minute, the M559 HEMTT Tanker could be emptied in about eight minutes if the receiving container could accept it at the same rate.

Therefore, arrival time, transfer time, and departure time would take about 6 1/2 hours with no time considerations for coordination and positive control. Conducting the replenishment with seven convoys and seven replenishment points would reduce the time to about 1 1/2 hours. To accomplish either of the above would require a well trained force that is finely tuned and traveling on numerous routes of access to, and egress from, the reconstitution site. To put the frosting on the cake (so to speak), the ammunition being transferred, under postulated Army 21 resupply concepts, would have been packaged into company sized packages, in rear areas (or even CONUS), labeled for a specific company by unit designation, and grouped into battalion size loads for movement to forward areas.

In summary, reconstitution (replenishment) of a committed regiment with four days supply of Classes I, III and V will require approximately 700 trucks and 175 trailers to haul the cargo and to effect the transfer under ideal conditions. Significant increases in time can be expected under adverse weather, poor visibility, freezing temperatures, nighttime, etc., conditions. This time can be significantly reduced (by a factor of

7) by breaking one large convoy and the cargo transfer site into seven separate convoys and transfer sites. Even greater savings in time might be achieved by arranging for an exchange of empty vehicles, with loaded vehicles" i.e., drivers are switched from each vehicle in each of the convoys. A note of caution however, although this is theoretically possible, it is unreasonable to expect a one-for one exchange of the same or similar type vehicles to occur wherein any type of major asset accountability could be maintained.

APPENDIX A

Unit Reference Data

UNIT REFERENCE DATA

Division 86 Regimental Unit	FM 101-10-1 Unit	TOE	Page	Figure
HQ & HQ Company, Mech. Inf. Div.	HHC, Mech. Div.	37-42H	3-28	3-17
Mech. Inf. Battalion	Mech. Bn., Mech. Div.	7-45H	3-37	3-21
Tank Battalion	Tank Bn., Armor Div.	7-35H	3-37	3-21
Field Artillery Battalion	155mm How. Bn., Mech. Div.	6-365H	3-28	3-17
Field Artillery Battery	8" How. Btry., Mech. Div.	6-397H	3-28	3-17
Cavalry Squadron	Arm'd. Cav. Sqdn., Mech. Div.	17-105H	3-28	3-17
Aviation Battalion	Avn. Bn., Inf. Div.	57-55H	3-33	3-19
Air Defense Artillery Battalion	ADA Bn., Mech. Div.	44-325H	3-29	3-17
Signal Company	Fwd. Comm. Co., Mech. Div.	11-38H	3-28	3-17
Engineer Company	Cbt. Engr. Co., Mech. Div.	5-147H	3-28	3-17
Military Police Company	M.P. Co., Inf. Div.	19-27H	3-33	3-19
Electronic Warfare Company	No planning factors			
Chemical Warfare Company	No planning factors			
HQ & HQ Company, Regimental Support Force	HHC, DISCOM, Mech. Div.	29-2H	3-29	3-17
Maintenance Company	Fwd. Supt. Co., Maint Bn., Mech. Div.	29-27H	3-29	3-17
Transportation Company	TMT Co., S&T Bn., Mech. Div.	55-84H	3-29	3-17
Forward Support Company	S&S Co., S&T Bn., Mech. Div.	10-7H	3-29	3-17
Medical Company	Med Co., Med Bn., Mech. Div.	8-37H	3-29	3-17
Aviation Company	Trans. Acft. Maint. Co., Maint. Bn., Inf. Div.	55-89H	3-34	3-19

APPENDIX B

Replenishment Requirements, Mechanized Infantry Regiment

(6000 Personnel, 100 Kilometer Displacement Per Day)

REPLENISHMENT REQUIREMENTS, MECHANIZED INFANTRY REGIMENT
(6000 Personnel, 100 Kilometer Displacement Per Day)

CLASS I	Notes	1 Day	2 Days	3 Days	4 Days	5 Days
Rations, S/T	1	322	644	966	1,288	1,610
Water, Gal.	2	24,000	48,000	72,000	96,000	120,000
CLASS III	3					
MOGAS, Gal.	4	9,329	18,658	27,987	37,316	46,645
Diesel, Gal.	4	30,424	60,848	91,272	121,696	152,120
JP-4, Gal.	5	38,424	76,848	115,272	153,696	192,120
CLASS V, S/T		1,000	2,000	3,000	4,000	5,000
Total Dry Cargo, S/T		1,322	2,644	3,966	5,288	6,610
Rations		(322)	(644)	(966)	(1,288)	(1,610)
Ammunition		(1,000)	(2,000)	(3,000)	(4,000)	(5,000)
Total Wet Cargo, Gal.		102,177	204,354	306,531	408,708	510,885
Water		(22,000)	(44,000)	(66,000)	(88,000)	(110,000)
Fuel		(72,177)	(156,354)	(234,531)	(312,708)	(390,885)

NOTES

1. 6.7 pounds/person/day. 1 + 31 to D + 120 factor: 1.6
2. East European scenarios: 4 gal/man/day. Without TOEs, no computation were made for vehicles. Rate is 3 to 1 gallon/day/vehicle.
3. Usage factors for the mechanized infantry and armor battalions were increased by 20% for TCSSVs. Usage factors for the artillery battalion and battery were increased by 100% for FAASVs
4. Factors include: Displacement rate (MOGAS - 63.3 gal/km/day and Diesel - 197.9 gal/km/day; Supply - 10 of displacement rate; Service - 16 of displacement rate; and Waste - 10 of the sum of the displacement rate, supply and service
5. Aviation battalion, aviation company, and cavalry squadron: 6,404 gal/hr. A 3:1 ratio of maintenance to flight hours = 6 flight hours per day (higher ratios would not be unreasonable).

APPENDIX C

References

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